

BUK71/794R1-40BT

TrenchMOS™ standard level FET

Rev. 01 — 4 November 2004

Product data

1. Product profile

1.1 Description

N-channel enhancement mode field-effect power transistor in a plastic package using Philips High-Performance Automotive (HPA) TrenchMOS™ technology. The devices include TrenchPLUS diodes for over-temperature protection.

Product availability:

BUK714R1-40BT in SOT426 (D²-PAK)

BUK794R1-40BT in SOT263B (TO-220AB).

1.2 Features

- Integrated temperature sensor
- Q101 compliant
- Very low on-state resistance
- 175 °C rated.

1.3 Applications

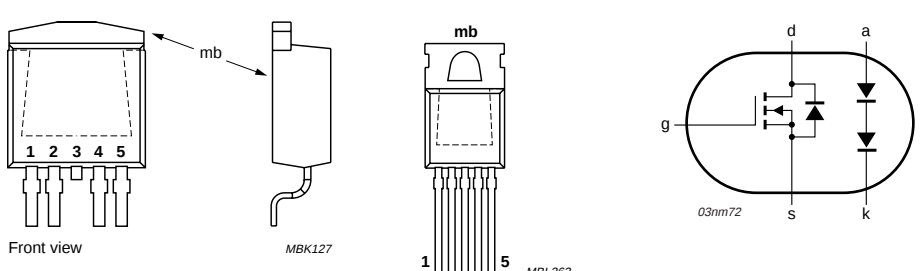
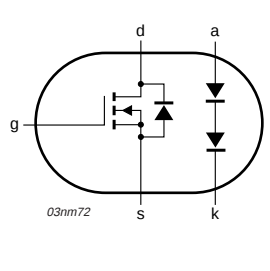
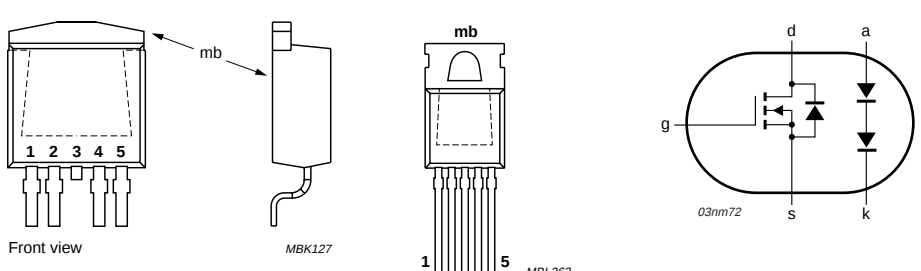
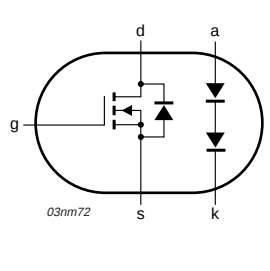
- Electrical Power Assisted Steering
- 12 V loads
- Motors, lamps and solenoids
- General purpose power switching.

1.4 Quick reference data

- $R_{DS(on)} = 3.4 \text{ m}\Omega$ (typ)
- $I_D \leq 75 \text{ A}$
- $V_{DS} \leq 40 \text{ V}$
- $P_{tot} \leq 272 \text{ W}$.

2. Pinning information

Table 1: Pinning - SOT426 and SOT263B, simplified outline and symbol

Pin	Description	Simplified outline	Symbol
1	gate (g)		
2	anode (a)		
3	drain (d)		
4	cathode (k)		
5	source (s)		
mb	mounting base; connected to drain (d)		
		SOT426 (D²-PAK)	SOT263B (TO-220AB)



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3. Limiting values

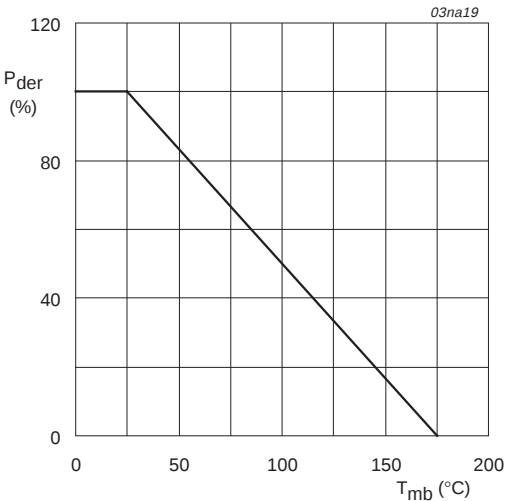
Table 2: Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{DS}	drain-source voltage (DC)		-	40	V
V_{DGR}	drain-gate voltage (DC)	$R_{GS} = 20\text{ k}\Omega$	-	40	V
V_{GS}	gate-source voltage (DC)		-	± 20	V
I_D	drain current (DC)	$T_{mb} = 25\text{ }^\circ\text{C}$; $V_{GS} = 10\text{ V}$; Figure 2 and 3	[1] -	187	A
			[2] -	75	A
		$T_{mb} = 100\text{ }^\circ\text{C}$; $V_{GS} = 10\text{ V}$; Figure 2	[2] -	75	A
I_{DM}	peak drain current	$T_{mb} = 25\text{ }^\circ\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$; Figure 3	-	748	A
P_{tot}	total power dissipation	$T_{mb} = 25\text{ }^\circ\text{C}$; Figure 1	-	272	W
T_{stg}	storage temperature		-55	+175	$^\circ\text{C}$
T_j	junction temperature		-55	+175	$^\circ\text{C}$
Source-drain diode					
I_{DR}	reverse drain current (DC)	$T_{mb} = 25\text{ }^\circ\text{C}$	[1] -	187	A
			[2] -	75	A
I_{DRM}	peak reverse drain current	$T_{mb} = 25\text{ }^\circ\text{C}$; pulsed; $t_p \leq 10\text{ }\mu\text{s}$	-	748	A
Avalanche ruggedness					
$E_{DS(AL)S}$	non-repetitive drain-source avalanche energy	unclamped inductive load; $I_D = 75\text{ A}$; $V_{DS} \leq 40\text{ V}$; $V_{GS} = 10\text{ V}$; $R_{GS} = 50\text{ }\Omega$; starting $T_{mb} = 25\text{ }^\circ\text{C}$	-	1.5	J
Electrostatic discharge					
V_{esd}	Electrostatic discharge voltage; pins 1,3,5	Human Body Model; $C = 100\text{ pF}$; $R = 1.5\text{ k}\Omega$	-	4	kV

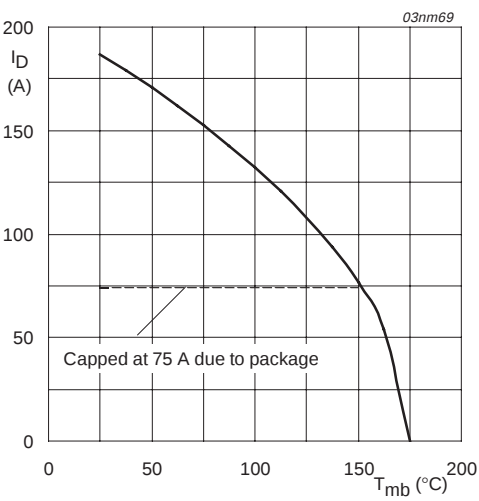
[1] Current is limited by power dissipation chip rating.

[2] Continuous current is limited by package.



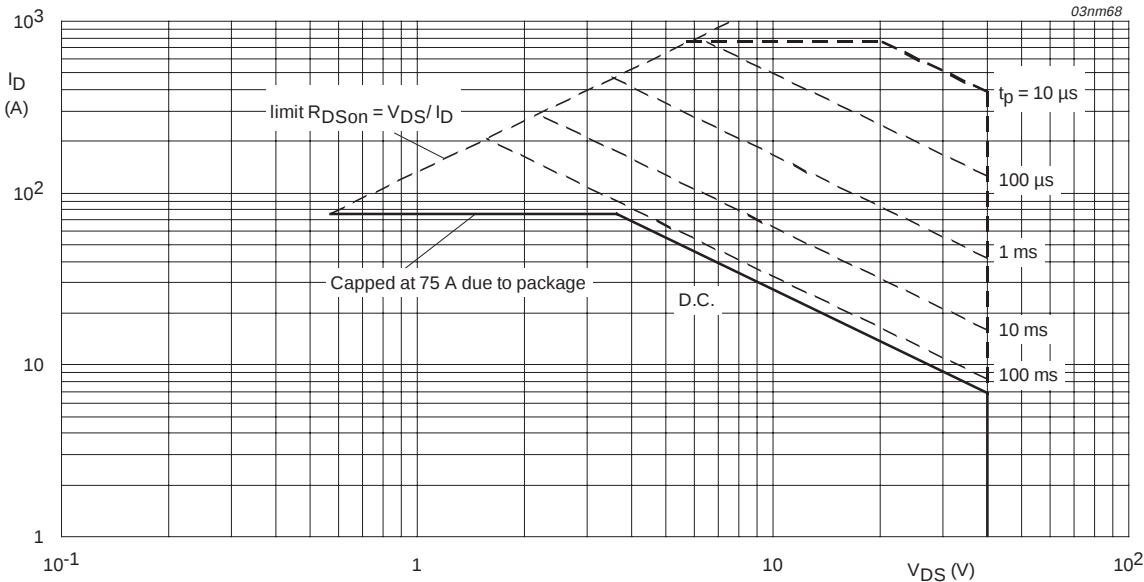
$$P_{der} = \frac{P_{tot}}{P_{tot(25^{\circ}C)}} \times 100\%$$

Fig 1. Normalized total power dissipation as a function of mounting base temperature.



$V_{GS} \geq 10$ V

Fig 2. Continuous drain current as a function of mounting base temperature.



$T_{mb} = 25$ °C; I_{DM} single pulse.

Fig 3. Safe operating area; continuous and peak drain currents as a function of drain-source voltage.

4. Thermal characteristics

Table 3: Thermal characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$R_{th(j-mb)}$	thermal resistance from junction to mounting base	Figure 4	-	-	0.55	K/W
$R_{th(j-a)}$	thermal resistance from junction to ambient					
	SOT263B (TO-220AB)	vertical in still air	-	-	60	K/W
	SOT426 (D ² -PAK)	minimum footprint; mounted on a PCB	-	-	50	K/W

4.1 Transient thermal impedance

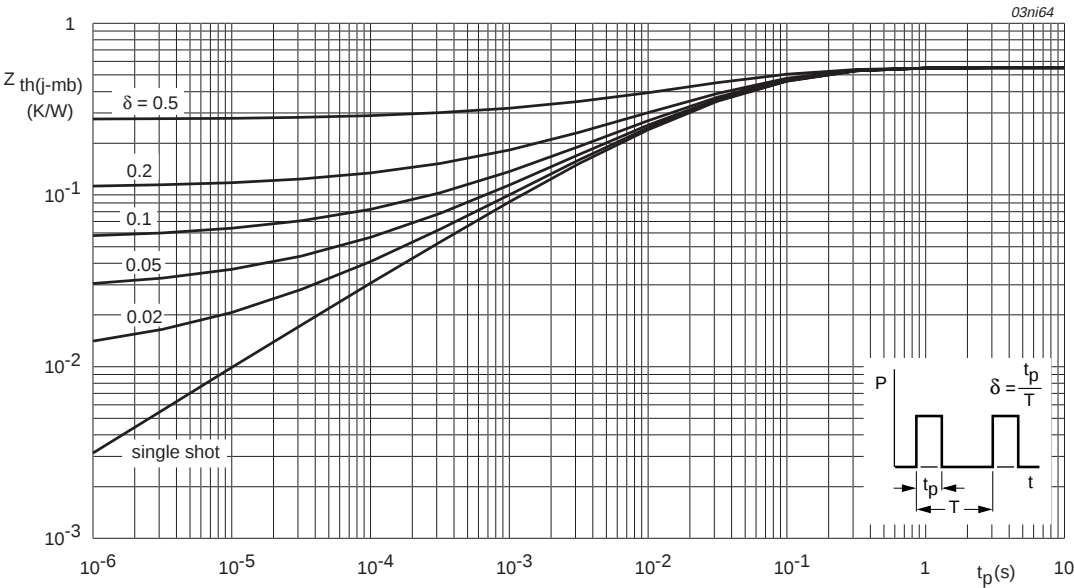


Fig 4. Transient thermal impedance from junction to mounting base as a function of pulse duration.

5. Characteristics

Table 4: Characteristics

$T_j = 25\text{ °C}$ unless otherwise specified

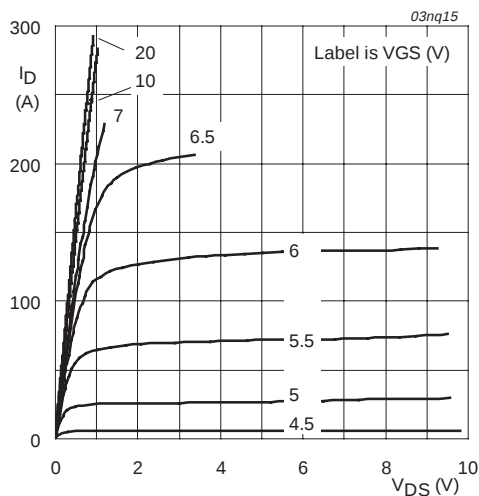
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Static characteristics						
$V_{(BR)DSS}$	drain-source breakdown voltage	$I_D = 0.25\text{ mA}$; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	40	-	-	V
		$T_j = -55\text{ °C}$	36	-	-	V
$V_{GS(th)}$	gate-source threshold voltage	$I_D = 1\text{ mA}$; $V_{DS} = V_{GS}$; Figure 9				
		$T_j = 25\text{ °C}$	2	3	4	V
		$T_j = 175\text{ °C}$	1	-	-	V
		$T_j = -55\text{ °C}$	-	-	4.4	V
I_{DSS}	drain-source leakage current	$V_{DS} = 40\text{ V}$; $V_{GS} = 0\text{ V}$				
		$T_j = 25\text{ °C}$	-	0.02	1	μA
		$T_j = 175\text{ °C}$	-	-	500	μA
I_{GSS}	gate-source leakage current	$V_{GS} = \pm 20\text{ V}$; $V_{DS} = 0\text{ V}$	-	2	100	nA
$R_{DS(on)}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 50\text{ A}$; Figure 7 and 8				
		$T_j = 25\text{ °C}$	-	3.4	4.1	m Ω
		$T_j = 175\text{ °C}$	-	-	7.8	m Ω
V_F	temperature sense diode forward voltage	$I_F = 1\text{ mA}$	1.58	1.60	1.63	V
S_F	temperature sense diode temperature coefficient	$I_F = 1\text{ mA}$; $-55\text{ °C} < T_j < 175\text{ °C}$	-2.55	-2.83	-3.11	mV/K
Dynamic characteristics						
$Q_{g(tot)}$	total gate charge	$V_{GS} = 10\text{ V}$; $V_{DD} = 32\text{ V}$; $I_D = 25\text{ A}$; Figure 14	-	83	-	nC
Q_{gs}	gate-to-source charge		-	18	-	nC
Q_{gd}	gate-to-drain (Miller) charge		-	29	-	nC
C_{iss}	input capacitance	$V_{GS} = 0\text{ V}$; $V_{DS} = 25\text{ V}$; $f = 1\text{ MHz}$; Figure 12	-	5106	6808	pF
C_{oss}	output capacitance		-	1389	1667	pF
C_{rss}	reverse transfer capacitance		-	527	721	pF
$t_{d(on)}$	turn-on delay time	$V_{DD} = 30\text{ V}$; $R_L = 1.2\text{ }\Omega$; $V_{GS} = 10\text{ V}$; $R_G = 10\text{ }\Omega$	-	38	-	ns
t_r	rise time		-	82	-	ns
$t_{d(off)}$	turn-off delay time		-	141	-	ns
t_f	fall time		-	90	-	ns
L_d	internal drain inductance	from drain lead 6 mm from package to center of die	-	4.5	-	nH
		from contact screw on mounting base to center of die SOT263B	-	3.5	-	nH
		from upper edge of drain mounting base to center of die SOT426	-	2.5	-	nH

Table 4: Characteristics...continued $T_j = 25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
L_s	internal source inductance	from source lead to source bond pad; lead length 6 mm	-	7.5	-	nH

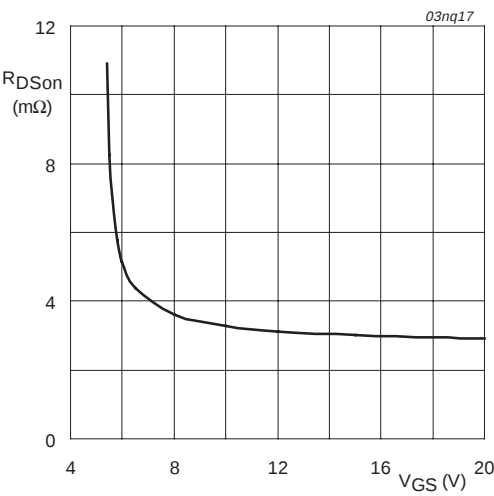
Source-drain diode

V_{SD}	source-drain (diode forward) voltage	$I_S = 25\text{ A}$; $V_{GS} = 0\text{ V}$; Figure 16	-	0.85	1.2	V
t_{rr}	reverse recovery time	$I_S = 20\text{ A}$; $dI_S/dt = -100\text{ A}/\mu\text{s}$	-	70	-	ns
Q_r	recovered charge	$V_{GS} = -10\text{ V}$; $V_{DS} = 30\text{ V}$	-	55	-	nC



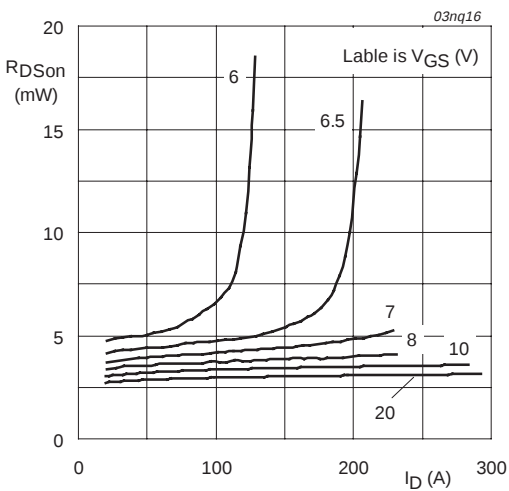
$T_j = 25^\circ\text{C}$; $t_p = 300\ \mu\text{s}$

Fig 5. Output characteristics: drain current as a function of drain-source voltage; typical values.



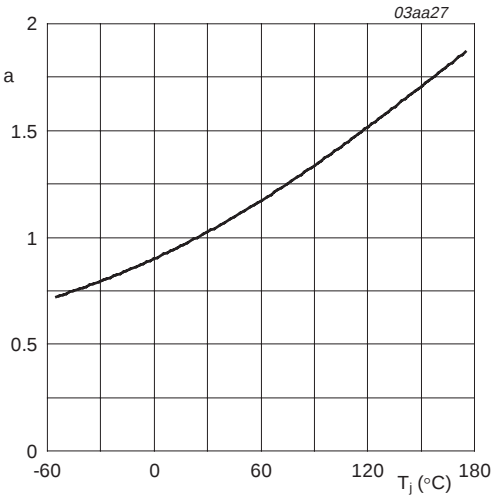
$T_j = 25^\circ\text{C}$; $I_D = 50\ \text{A}$

Fig 6. Drain-source on-state resistance as a function of gate-source voltage; typical values.



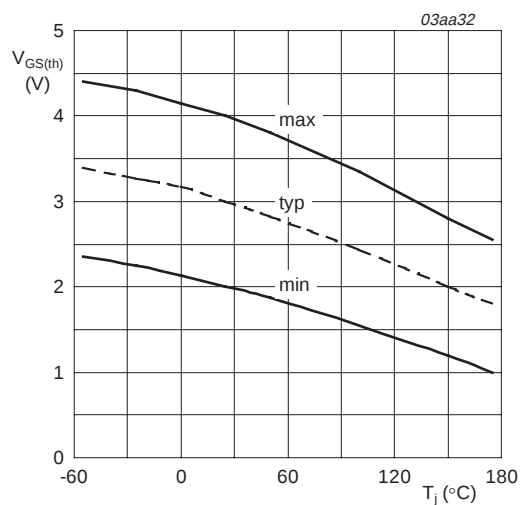
$T_j = 25^\circ\text{C}$

Fig 7. Drain-source on-state resistance as a function of drain current; typical values.



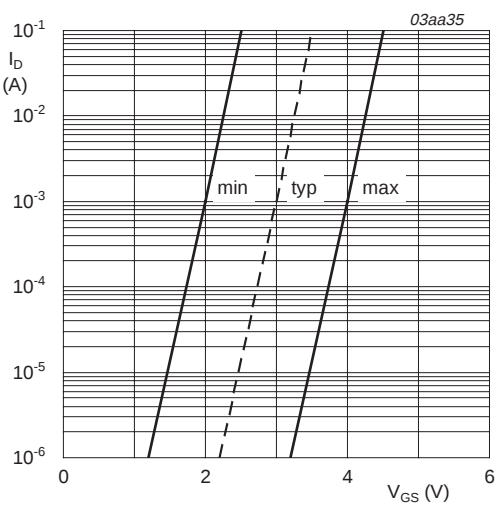
$$a = \frac{R_{DSon}}{R_{DSon(25^\circ\text{C})}}$$

Fig 8. Normalized drain-source on-state resistance factor as a function of junction temperature.



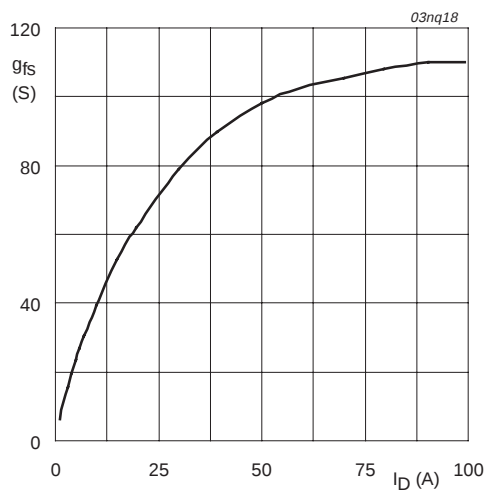
$I_D = 1 \text{ mA}$; $V_{DS} = V_{GS}$

Fig 9. Gate-source threshold voltage as a function of junction temperature.



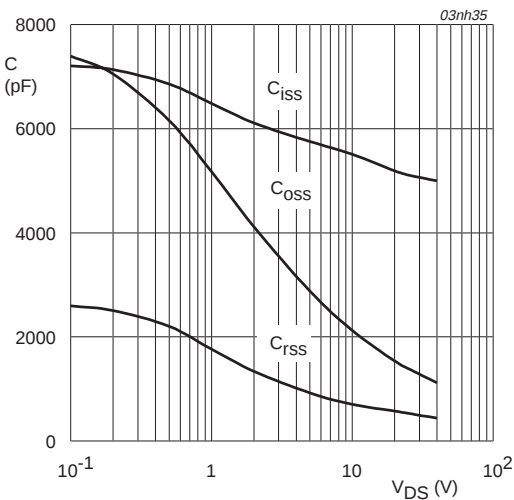
$T_j = 25 \text{ °C}$; $V_{DS} = V_{GS}$

Fig 10. Sub-threshold drain current as a function of gate-source voltage.



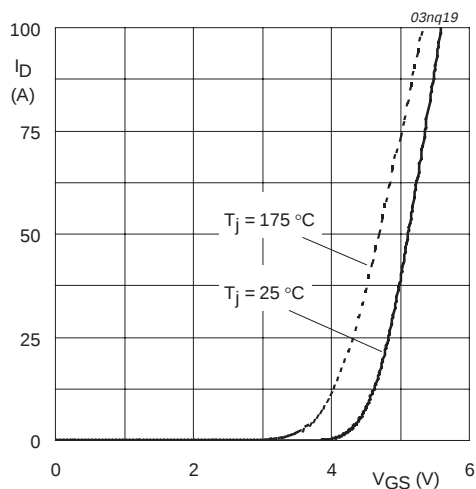
$T_j = 25 \text{ °C}$; $V_{DS} = 25 \text{ V}$

Fig 11. Forward transconductance as a function of drain current; typical values.



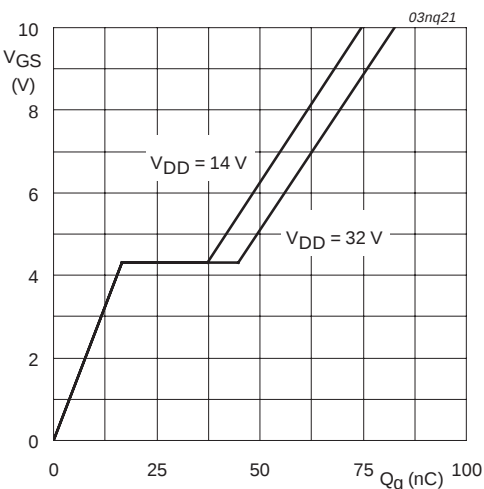
$V_{GS} = 0 \text{ V}$; $f = 1 \text{ MHz}$

Fig 12. Input, output and reverse transfer capacitances as a function of drain-source voltage; typical values.



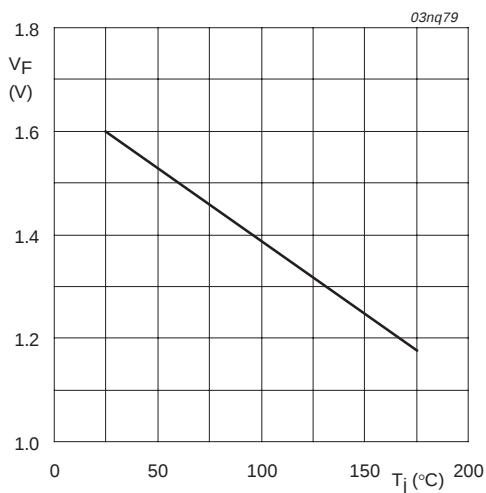
$V_{DS} = 25\text{ V}$

Fig 13. Transfer characteristics: drain current as a function of gate-source voltage; typical values.



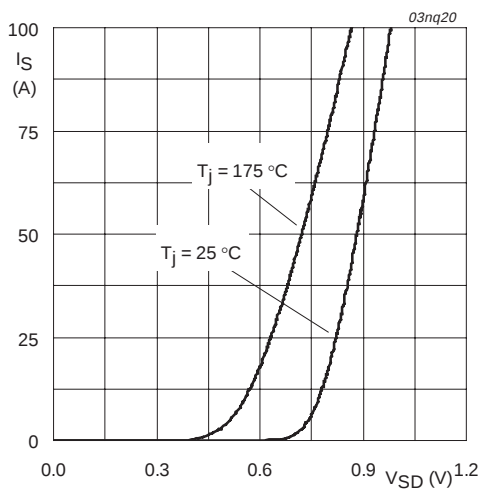
$T_j = 25\text{ }^\circ\text{C}; I_D = 25\text{ A}$

Fig 14. Gate-source voltage as a function of turn-on gate charge; typical values.



$I_F = 1\text{ mA}$

Fig 15. Forward voltage of temperature sense diode as a function of junction temperature; typical values.



$V_{GS} = 0\text{ V}$

Fig 16. Reverse diode current as a function of reverse diode voltage; typical values.

6. Package outline

Plastic single-ended package; heatsink mounted; 1 mounting hole; 5-lead TO-220

SOT263B

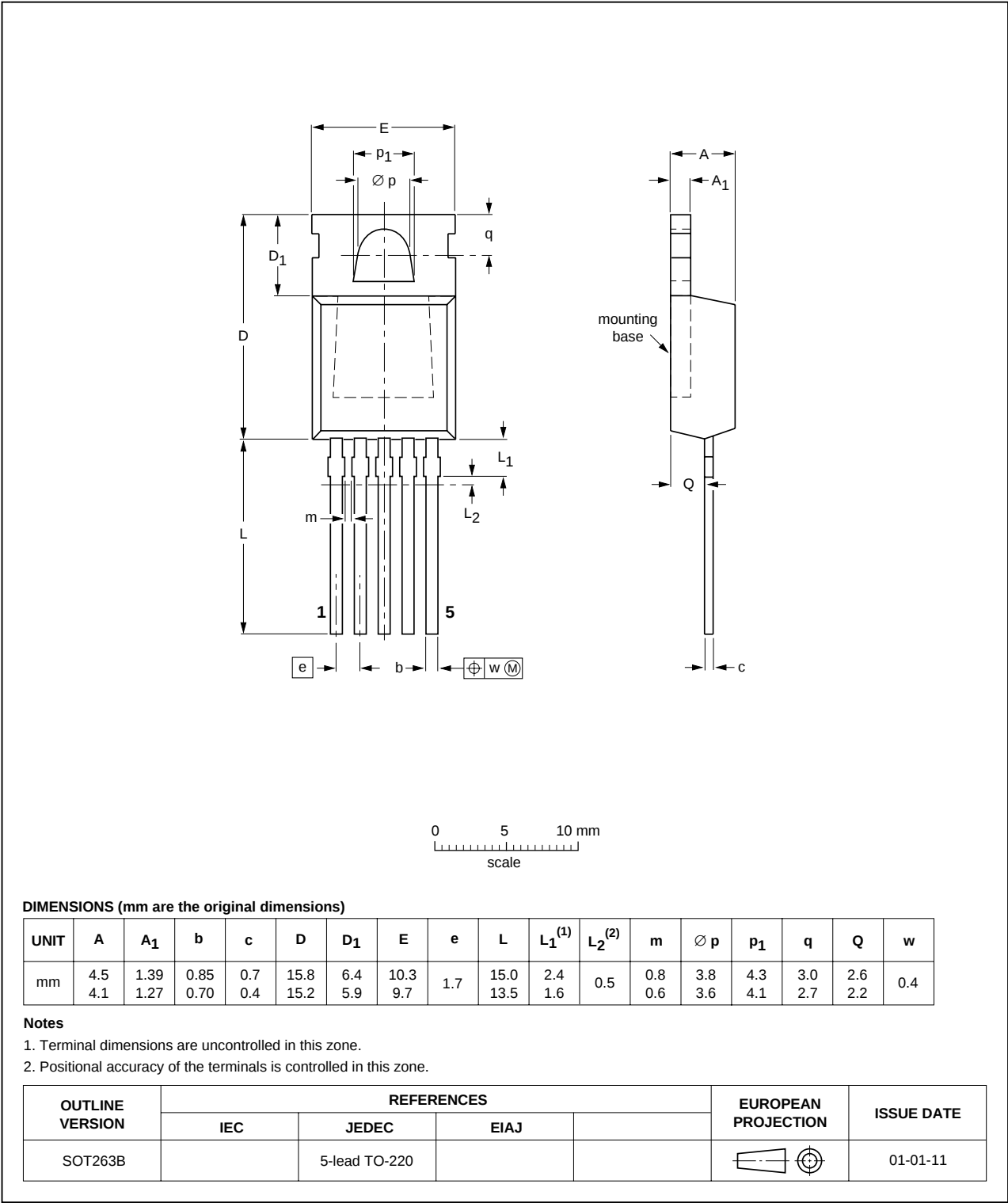
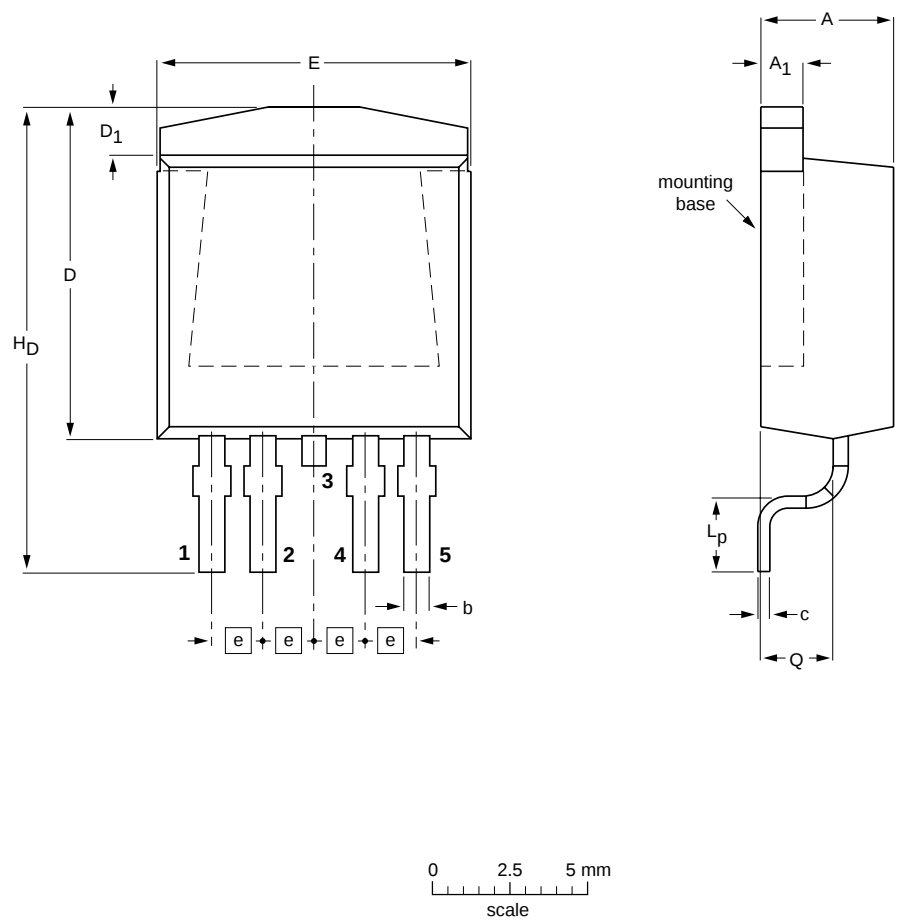


Fig 17. SOT263B (TO-220AB).

Plastic single-ended surface mounted package (D²-PAK); 5 leads (one lead cropped)

SOT426



DIMENSIONS (mm are the original dimensions)

UNIT	A	A ₁	b	c	D _{max.}	D ₁	E	e	L _p	H _D	Q
mm	4.50 4.10	1.40 1.27	0.85 0.60	0.64 0.46	11	1.60 1.20	10.30 9.70	1.70	2.90 2.10	15.80 14.80	2.60 2.20

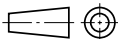
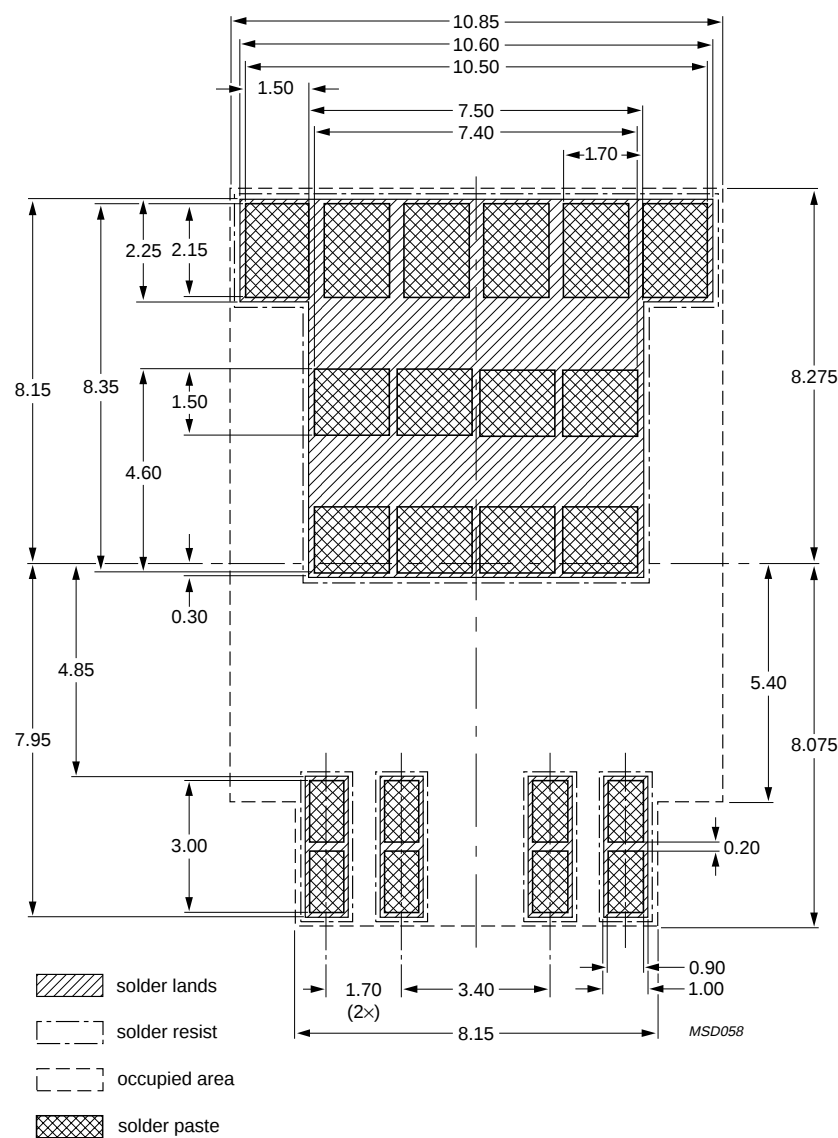
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT426						99-06-25 04-10-13

Fig 18. SOT426 (D²-PAK)

7. Soldering



Dimensions in mm.

Fig 19. Reflow soldering footprint for SOT426.

8. Revision history

Table 5: Revision history

Rev	Date	CPCN	Description
01	20041104	-	Product data; initial version.

9. Data sheet status

Level	Data sheet status ^[1]	Product status ^{[2][3]}	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

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Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

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